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Ultrasound surveillance in twin pregnancy: An update for practitioners

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Abstract

Ultrasound has revolutionised the management of multiple pregnancies and their complications. Increasing frequency of twin pregnancies mandates familiarity of all clinicians with the relevant pathologies and evidence-based surveillance and management protocols for their care. In this review, we summarise the latest evidence relating to ultrasound surveillance of twin pregnancies including first trimester assessment and screening, growth surveillance and the detection and management of the complications of monochorionic pregnancies including twin-to-twin-transfusion syndrome, selective fetal growth restriction, twin reversed arterial perfusion sequence and conjoined twinning.

Keywords

Twins, monochorionic, dichorionic, screening, ultrasound

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Introduction

Since the introduction of ultrasound into routine obstetric practice, the advantages for the mothers carrying twins have moved beyond the simple ability to identify multiple pregnancies antenatally to the possibility of screening these pregnancies both for the same pathologies as those screened for in singleton pregnancies, as well as the identification and management of those complications specific to twin pregnancies.[1–3]

As twins continue to increase in frequency,[4] routine ultrasound surveillance for the complications of twin pregnancies is becoming a common task and, therefore, familiarity with the clinical problems specific to twin pregnancies is important for all team members. National guidelines recommend that women with twin pregnancies are looked after by a core multidisciplinary team, which includes obstetricians, midwives and sonographers, who are familiar with the management of complicated and uncomplicated twin pregnancies, in order to optimise their outcomes.[5]

We present an appraisal of the latest evidence relating to the use of ultrasound in the screening for antenatal complications from the early first trimester, screening for fetal abnormalities, twin-specific complications, preterm birth and pre-eclampsia, as well as the application of ultrasound in the management of complicated twin pregnancies. Higher order multiple pregnancies were outside the scope of this review.

The first trimester scan in twin pregnancies

Given the high risk of preterm delivery in twins,[6] accurate first trimester dating is important in later management of the pregnancy. After dating and determination of the diagnosis of multiple pregnancy, the most important additional information to determine is the precise number of fetuses and the chorionicity (number of placentae) and amnionicity (number of amniotic sacs) of the pregnancy.

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Dating

Dating of the pregnancy using the crown-rump length (CRL) prior to 14 weeks gestation is the standard practice in twins, as the case in singletons.[7] Through natural variation, multiple fetuses will rarely be identical in size even at the earliest of gestations. The operator can choose the largest, the smallest, or the mean of the two CRLs to date the pregnancy. It is thought that the smaller CRL is the most reflective of true gestational age, based on studies where the date of conception is definitively known.[8,9] The risk of using the smaller CRL to date the pregnancy lies in the possibility of assuming that the larger twin is 'large for dates' and failing to diagnose a growth restricted smaller twin.

As twin CRLs have been shown to straddle the mean of singleton pregnancies, it could be reasonable to use the mean of the two CRL measurements to date the pregnancy as well[10] but it has been shown that only the use of the larger twin to date the pregnancy leads to a slight overestimation of true gestational age, whereas use of the mean or the smaller twin are both associated with underestimates.[11] The most common choice is therefore to use the larger CRL for pregnancy dating[5,7,12] because this protects against missing a diagnosis of IUGR (intra-uterine growth restriction) in the smaller twin. In twin pregnancies conceived via IVF, as with singleton IVF pregnancies, the gestational age should be calculated using the date of embryo transfer.[7]

Chorionicity

While the majority (>80%) of twin pregnancies are dichorionic, monochorionic pregnancies are associated with worse perinatal outcomes, are affected by several conditions specific to twins sharing a placental circulation and require significantly more antenatal surveillance.[13]

The signs available to determine chorionicity vary by gestation and, in general, the diagnosis is more accurate the earlier in pregnancy the twins are assessed. Prior to 10 weeks gestation, the presence of two gestational – amniotic and yolk sacs – clearly identifies a dichorionic diamniotic (DCDA) pregnancy.[12] After 10 weeks, the number of placental masses may be identified but since monochorionic placentae may be bilobar and thus appear as two distinct masses, this marker should be assessed in context of other indicators of chorionicity such as intertwin membrane thickness, fetal gender and layers in the intertwin membrane.

The presence of a chorionic peak or the 'lambda sign' (Figure 1(a)) usually indicates a dichorionic pregnancy in comparison to the 'T sign' (Figure 1(b)) that is associated with a monochorionic pregnancy. This sign is related to the thickness of the intertwin membrane which in a DCDA pregnancy is made of up four layers (chorion/amnion/amnion/chorion) that create the thicker 'chorionic peak' in comparison to the double layer (amnion/amnion) in the monochorionic (MCDA) pregnancies.[12,14] In monochorionic monoamniotic (MCMA) pregnancies no membrane is seen, but a careful examination must take place in order to exclude the presence of a thin free floating intertwin membrane. Discordant fetal sex is virtually always associated with DCDA pregnancy and can be used as a marker for chorionicity where present, but of course concordant fetal sex does not rule out dichorionicity.

Accuracy in determining chorionicity at less than 14 weeks has been reported at 99%, but this falls to only 77% sensitivity for monochorionicity in assessments carried out after 14 weeks, underlining the importance of early clarification of chorionicity. Where one operator is uncertain, a second opinion should be sought without delay.[15]

Twin labeling

Labeling of the twins begins at the first scan and should be consistent at every subsequent scan. The strategy

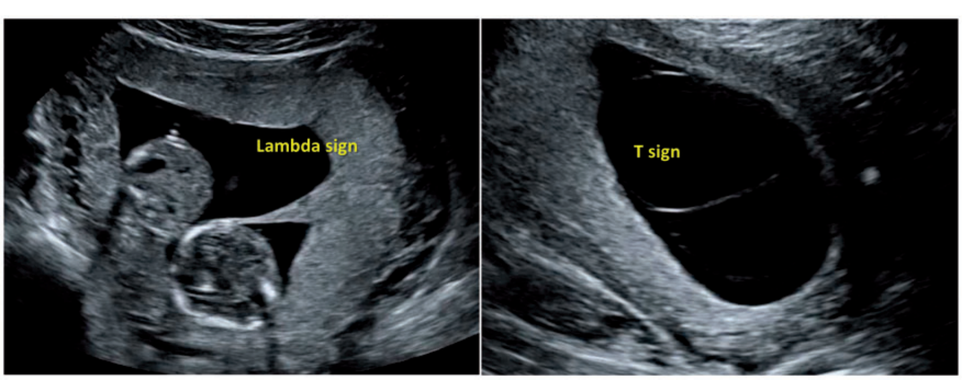

Figure 1. Lambda sign (a) associated with dichorionic pregnancy compared to the 'T' sign (b) of monochorionic pregnancy (authors own image).

must be applied by all professionals undertaking studies of the same pregnancy.[7] It is good practice to describe each twin as fully as possible (e.g. twin 1 is female, on maternal left and has anterior placenta, while twin 2 is male, on maternal right and has a posterior placenta) to minimise the chance of confusion and may be helpful to represent the twins relative positions diagrammatically in the maternal notes.

Screening for aneuploidy in twins

The combined screening test (nuchal translucency (NT), maternal serum beta-human chorionic gonadotophin (bHCG) and pregnancy-associated plasma protein-A (PAPP-A) was recommended for use in the UK by the NHS FASP in their 2003 Model of Best Practice[16] and has since become the preferred screening test for singleton pregnancies. In twin pregnancies, the detection rate of the combined test for Trisomy 21 is lower than that in singletons (>90%), but the false positive rate is higher, potentially leading to more invasive testing in these pregnancies. The incorporation of the NT into the combined test allows a fetus specific risk to be assigned in dichorionic pregnancies. Since monochorionic twins share a karyotype, the risk calculated takes into account a mean of the NT measurements and a per pregnancy risk is given, as is the case with all serum only screening tests.[17] Where a twin pregnancy spontaneously reduces to a singleton pregnancy in the first trimester (the 'vanishing twin' phenomenon), care must be taken in applying first trimester screening with the combined test. The later in the pregnancy that loss of the second twin occurs, the greater the potential residual effect of the second pregnancy on the biomarkers used in the combined test.[18] Where the effect is considered to compromise the screening test, as is the case when an embryonic mass is visualised, screening should be performed using the NT only.[19]

Invasive testing in twins

Invasive testing in twin pregnancy has been thought to be associated with higher risk than in singleton pregnancy, but it can be difficult to separate the effect of invasive testing from the higher rate of spontaneous miscarriage in twin pregnancy in the available observational data. Although the pregnancy loss rate is 3–4%,[20] the excess risk of miscarriage associated with second trimester amniocentesis in twins is estimated to be 1%.[21] It is clearly important to be certain that both twins have been sampled when invasive testing is performed, even where the pregnancy is thought to be monochorionic. For amniocentesis, both single and double uterine entry techniques are described, with little clear difference between the two in terms of perinatal outcomes.[22]

Non-invasive prenatal testing in twins

Cell-free fetal DNA (cffDNA) testing has been recently introduced into practice for aneuploidy screening in singleton pregnancies with excellent detection rates (>99% for trisomy 21 with a false positive rate of <0.1%). Since twins are associated both with an increased risk of aneuploidy and greater risks of miscarriage after invasive testing the advantages of NIPT could be significant in twin pregnancies, but no studies large enough to accurately report the test performance in twins have yet been published. The findings of a recent analysis suggest that where a result is obtained the detection rates are similar to those in singleton pregnancies.[23] Despite the advent of NIPT, the first trimester scan remains critical in twin pregnancies for accurate dating and determination of chorionicity.

Screening for fetal structural abnormalities in twins

Anomaly screening in twins

As with singleton pregnancies, fetal anomaly scans are recommended at 18–20+6 weeks to identify structural anomalies in twin pregnancies.[5,7] The risk of fetal anomaly is greater than in singleton pregnancies and the scans are more technically demanding because of the presence of two fetuses, so a skilled operator should perform these scans and additional time should be allowed to adequately assess all the fetal anatomy. It is particularly important to save images clearly labeled by twin to ensure consistency between scans – ideally by text and colour.

Discordant anomalies in twin pregnancies

Around 1 in 25 DCDA and 1 in 15 MCDA twin pairs will be affected by major congenital anomaly, usually affecting only one twin.[24] Cardiac anomalies in particular are more common in monochorionic pregnancies and therefore detailed examination of the heart is recommended in MC pregnancies.[25]

The management of fetal structural anomalies is complicated in twin pregnancies where the affected fetus shares the intrauterine environment with a sibling that may be unaffected or present different disorders. The management will be determined by the expected prognosis for the affected twin and the chorionicity of the pregnancy.

Where intrauterine demise of the affected twin is anticipated, expectant management is appropriate in dichorionic pregnancies with a low risk of preterm labour and delivery of the surviving co-twin.[26] In monochorionic pregnancies, demise of one twin is more often followed by neurological injury (24% compared to 2%) or death of the unaffected co-twin (15% compared to 3%) because of the interdependent feto-placental circulation.[27,28] In this circumstance, selective feticide of the affected twin may be preferable. In all such cases, referral to a tertiary fetal medicine service for appropriate counselling and management is recommended.[5]

The use of second trimester uterine artery Doppler in twin pregnancies

Pre-eclampsia remains one of the most common causes of maternal and fetal morbidity and mortality. It is more common (7%) in twin pregnancies. Uterine artery Doppler waveforms measured at 20–22 weeks have been found to be predictive of pre-eclampsia, even in low-risk singleton pregnancies. It has been observed that the Uterine Artery Pulsatility Index (UAPI) is lower in twin pregnancies than in singletons with little difference between MC and DC pregnancies.[2,29] Using the highest measured PI provides the best test performance, with sensitivity for all pre-eclampsia of 26.5% and for early pre-eclampsia of 33.3%. Although the sensitivity of UAPI in twins is lower than in singleton pregnancies,[2] it is important to note that because pre-eclampsia is more common in twin pregnancies, the women carrying twins and identified by abnormal UAPI at 20–22 weeks will be amongst the highest risk of developing pre-eclampsia and for this reason some units will offer UAPI screening to identify women for additional monitoring for the signs and symptoms of pre-eclampsia throughout pregnancy.

Assessment of fetal growth in twins

Although twins and singletons in the second trimester seem to have similar growth patterns,[11] in the third trimester growth velocity in twins is consistently found to be less than in singletons, with the differences most pronounced and noted earlier in MC pregnancies.[30–32] The key question for clinicians to identify is does the difference in observed growth represent adaptation or true restriction?

If growth in twins is limited by the ability of the mother to supply the metabolic demands of two growing fetuses, does that suggest the need for twin-specific growth charts for twins because they just grow differently or merely demonstrate a physiological explanation for the observed increase in incidence of growth restriction in twins? If the former, then there is a need for twin-specific growth charts, but if the latter then there is an argument to continue using singleton growth charts in order to avoid the risk of failing to diagnose growth restriction in twin pregnancies. Additionally, EFW calculations are observed to be less accurate in twin pregnancies than in singletons, which also calls into question the validity of using singleton norms for management of twin pregnancies.[33]

Since it can be observed that twins are genuinely more at risk of stillbirth and perinatal loss than singletons,[34,35] the finding that twins are also likely to be smaller is plausibly also the finding that twins are more likely to be growth restricted. Caution should be used in assuming that twins are physiologically normal when smaller than the equivalently aged singletons. Despite this cautious approach, it has been demonstrated that the use of twin-specific charts leads to fewer babies being classified as growth restricted antenatally (and therefore likely to be subjected to additional interventions and scheduled delivery) without failing to identify small babies that go on to suffer intra-uterine demise. A number of studies have demonstrated that the use of twin-specific growth charts, taking chorionicity into account, are more accurate to detect twins at risk for intrauterine fetal demise and neonatal death.[30,36]

In order to most accurately identify fetuses with growth limited by placental insufficiency it may be the case that, as in singleton pregnancies, the addition of Doppler parameters is of benefit in distinguishing the faltering fetus from the well small baby.[37]

Size discordance in twins

Although twins will rarely be identical in size, significant growth discrepancies are associated with poor perinatal outcomes in a continuous fashion and may be more important in relation to perinatal outcome than the absolute size of individual babies. Twins that are both constitutionally small are understandably at lower risk of complications than siblings, especially genetically identical siblings, that have significantly different growth trajectories in the same intra-uterine environment.

A growth discrepancy of 25% predicts poor perinatal outcomes in twins[33] and most national bodies recommend a discrepancy of 20–25% as a trigger for referral to fetal medicine experts or additional monitoring. NICE recommends that growth discrepancy should be calculated at every scan from 20 weeks using the formula ((weight of larger twin – weight of smaller twin)$\times$100)/weight of larger twin.[7] In dichorionic pregnancies, monitoring of the growth restricted twin is similar to monitoring for a singleton affected by IUGR, but the decision to deliver is complicated at very preterm gestations by the presence of the normally grown twin who might be iatrogenically compromised by prematurity if delivered at the same time as their struggling co-twin.

Frequency of growth assessment in twin pregnancies

Most international bodies recommend surveillance scanning of MC pregnancies every two weeks, on the basis that they are more at risk of all adverse perinatal outcomes than DC twins and additionally may develop selective fetal growth restriction (sFGR), twin-to-twin-transfusion syndrome (TTTS) or twin anaemia-polycythaemia sequence (TAPS) at any time during the pregnancy.[5,7,12,38] Longer scan intervals are likely to be associated with a more severe presentation at diagnosis of one of these complications and consequently also with poorer outcomes.[39]

There is relatively little evidence supporting the routine examination of DCDA twins every four weeks, or even every four to six weeks as recommended by some.[38] A large prospective study recently demonstrated excellent fetal outcomes in the DCDA twins included in their fortnightly research ultrasound protocol.[40] Secondary analysis later showed that if the scans had been done every four weeks, the detection rate of growth restriction and abnormal umbilical artery Doppler would have been lower, possibly leading to poorer perinatal outcomes.[41] This is a common sense finding – more screening finds more abnormalities, but decreasing the screening interval in dichorionic pregnancies has some obvious drawbacks. DCDA pregnancies represent >80% of twin pregnancies and, therefore, a doubling of scan requirements in this group has significant resource implications and would require formal health economic modeling. Furthermore, additional screening will lead to additional iatrogenic deliveries of babies suspected to be compromised, but in twin pregnancies these iatrogenic deliveries affect not only the mother but also any healthy co-twins and investigation of the potential harm to the co-twins would be necessary in considering change in screening protocols. The recommended frequency and content of ultrasound assessments for dichorionic and monochorionic twin pregnancies are shown in Figures 2 and 3.

Complications of monochorionic twinning

MC twins are vulnerable to complications of interdependent placental circulations in a way that DC pregnancies are not. These complications include TTTS (where a volume imbalance between the twins leads to progressive hypoxia in one twin and severe volume overload in the recipient), sFGR (where one twin only is significantly smaller than expected for

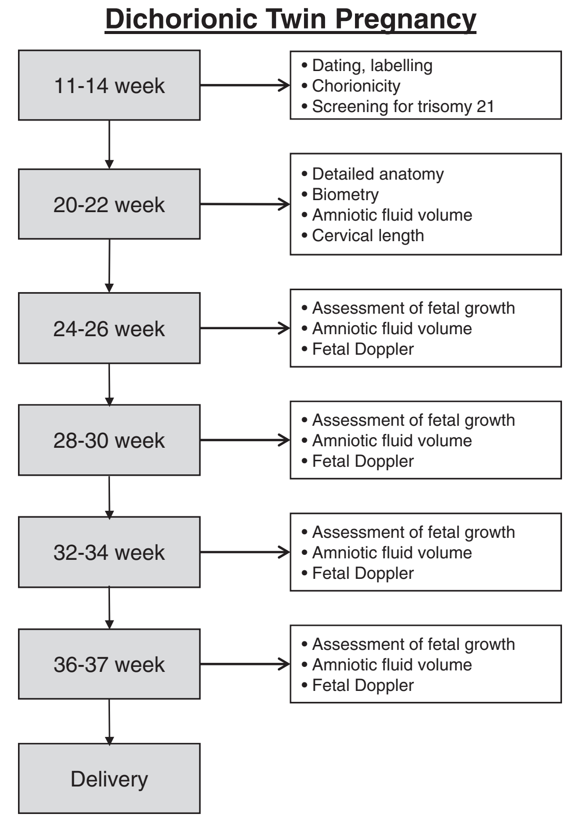

Figure 2. Recommended frequency and content of scans in dichorionic pregnancies.[7]

gestational age), TAPS (where there is haemoglobin discrepancy between twins without a volume difference) and the twin reversed arterial perfusion sequence (TRAP – where an acardiac twin exists dependent on collateral circulation from the normal ‘pump’ twin). Although these complications carry a heavy burden of fetal morbidity and mortality, ultrasound screening can facilitate interventions and delivery that can greatly improve outcomes.

First trimester prediction of complications of MC pregnancies

Predicting in the first trimester which MC pregnancies are likely to be complicated can be helpful in counseling parents about treatment options in advance. Pregnancies identified as low risk by a combination of CRL and amniotic fluid concordance have an excellent prognosis, with overall survival of around 95%,[24] so this finding can be highly reassuring to parents after the diagnosis of monochorionic pregnancy. Unfortunately, accurate prediction of TTTS and/or sFGR in the first trimester is yet to be achievable.

To predict TTTS and sFGR several parameters have been considered – CRL, NT, a-wave in the ductus venosus and amniotic fluid volumes. CRL has not

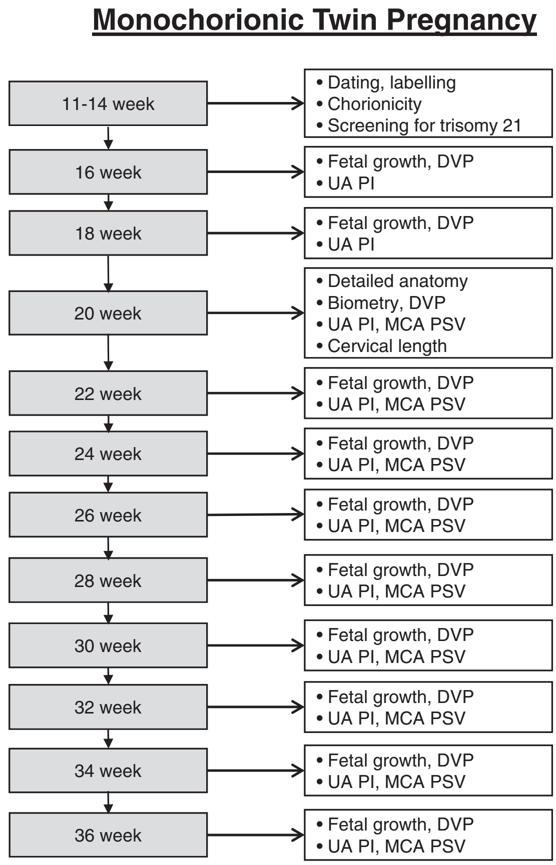

Figure 3. Recommended frequency and content of scans in monochorionic pregnancies.[7] DVP: deepest vertical pocket; UA PI: umbilical artery pulsatility index; MCA PSV: middle cerebral artery peak systolic velocity.

been found to be useful in the prediction of subsequent TTTS, but is of significance in sFGR in both MC and DC pregnancies.[1,42] The evidence regarding NT discrepancy as a predictor of TTTS is contradictory: although NT is plausibly related to a disparity in volume status and therefore with early TTTS, the association, when observed, does not seem to be strong enough to be clinically useful.[43]

Reversed a-wave in the fetal ductus venosus at 11–14 weeks was a better predictor of subsequent TTTS than either NT or CRL, but still reported a low positive predictive value.[44] Ultimately, no single parameter can be recommended for accurate prediction of complications in MC pregnancies in the first trimester, but operators should be aware of the increased risk particularly with multiple discrepancies between the twins.

Identification of TRAP pregnancies

A TRAP pregnancy can usually be identified in the first trimester, although the diagnosis may not be clear in very early scans (Figure 4). The TRAP sequence was thought to be extremely rare but improvements in early pregnancy imaging suggest that in fact this problem is more common than previously thought and may affect as many as 2.6% of MC pregnancies.[45] Since there is spontaneous demise of the acardiac twin in many cases, it is possible that some cases of the TRAP sequence are instead diagnosed as single fetal demise in the early first trimester. Optimal management of TRAP pregnancies can be achieved using intrafetal laser photocoagulation of the umbilical blood vessels in the acardiac twin, performed late in the first trimester. Expectant management is associated with high mortality in the pump twin, while survival after intrafetal laser therapy is around 80%.[46] It is likely that pregnancy outcomes are better in cases managed with fetal intervention at early gestations (<16 weeks), so early diagnosis is key and all practitioners scanning twins in the first trimester need to maintain an awareness of this condition.[46]

Twin-to-twin transfusion syndrome

Since the advent of fetoscopic laser coagulation, intervention can ameliorate the dismal prognosis in MC pregnancies affected by TTTS. The RCOG and other major national bodies recommend commencing screening for TTTS in MC pregnancies from 16 weeks. Staging of TTTS is according to the Quintero classification (Table 1). The staging requires amniotic fluid discrepancy,[47] which cannot be readily identified before 16 weeks, as until this time most of the amniotic fluid is derived from the placenta. TTTS is defined as significant amniotic fluid discrepancy (DVP >8 cm in one twin and <2 cm in the other) in monochorionic twin pregnancies until 20 weeks where the DVP cut off is 10 cm. This can lead to clinical uncertainty in the optimal management of twins presenting at gestations 16–18 weeks with significant discrepancy but a DVP of 6 or 7 in the presumed recipient. Since DVP has been now been observed to vary with gestation in monochorionic twin pregnancies,[48] despite previously having been thought to be stable throughout pregnancy,[49] it might be prudent in the future to consider a transition to diagnostic criteria modified to take account of variation in the amniotic fluid volume by gestation.[50] (Figure 5, Table 2) Additionally, intervention is technically challenging in the very early gestations, limiting the usefulness of earlier diagnosis. Extremely rare cases where dichorionic twins have developed placental anastamoses as well as the possibility of misclassification of chorionicity in early pregnancy mean that even in DC pregnancies significant discrepancies in amniotic fluid volumes require specialist assessment.[51]

The Quintero stage is only partially associated with prognosis. Additional ultrasound markers can be used

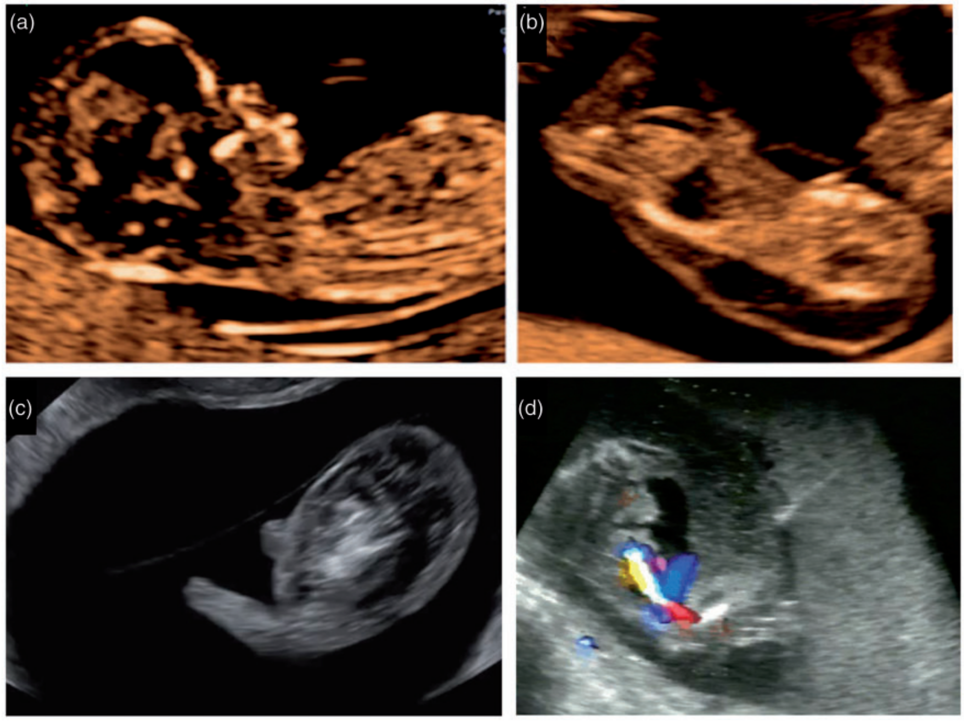

Figure 4. TRAP pregnancy – showing the normal and acardiac fetuses (author's own images).

Table 1. Quintero staging of twin-to-twin transfusion syndrome.[47]

Stage	Description
I	Discordant amniotic fluid volumes – DVP <2 cm in one and >8 cm in the other (before 20 weeks) or >10 cm after 20 weeks
II	Bladder of donor twin not visible
III	Critically abnormal Doppler studies in either twin (umbilical artery Doppler in the donor and/or venous Doppler in the recipient)
IV	Ascites, pericardial or pleural effusion or overt hydrops
V	Single or double intra-uterine death

DVP: deepest vertical pocket.

to guide prognosis and risk of progression, particularly in cases where difficult decisions regarding fetal interventions (selective fetoscopic laser coagulation (SFLC) or amnioreduction) or delivery are being weighed.

Pre-operatively identifiable factors found to be associated with fetal death include increasing EFW percentage discrepancy, ascites or hydrops in the recipient, absent or reversed a-wave in the ductus venosus, global cardiac dysfunction, pericardial effusion and valvular regurgitation.[52]

The degree of recipient cardiomyopathy has been associated with the likelihood of progression from Quintero Stages 1 and 2, and can be used to select patients for fetal intervention.[53] This finding has led to the development of a number of cardiovascular assessment scores to quantify fetal cardiomyopathy – the Children's Hospital of Philadelphia (CHOP) score and Cincinatti staging which are specific to TTTS while the cardiovascular profile score (CVPS) examines general cardiovascular wellbeing.[54] Diastolic dysfunction and abnormal cerebroplacental ratio have been found to precede overt evidence of cardiomyopathy in Stage I or II TTTS[55] and may also be of benefit in prognosis and determining frequency of follow up.

Ultrasound is further of benefit once a decision for fetal intervention has been made and will usually be undertaken by the operators prior to fetoscopic intervention. Mapping the placental borders helps plan trochar insertion and identifying the cord insertions shows where the anastomoses will be found, since they should chiefly lie between the two cord insertions.[51] The position of the donor twin can help predict the direction of travel of the vascular anastomoses and identifying the dividing membrane may reduce the risk of inadvertent septostomy. Detailed ultrasound for pre-operative planning can optimise entry point

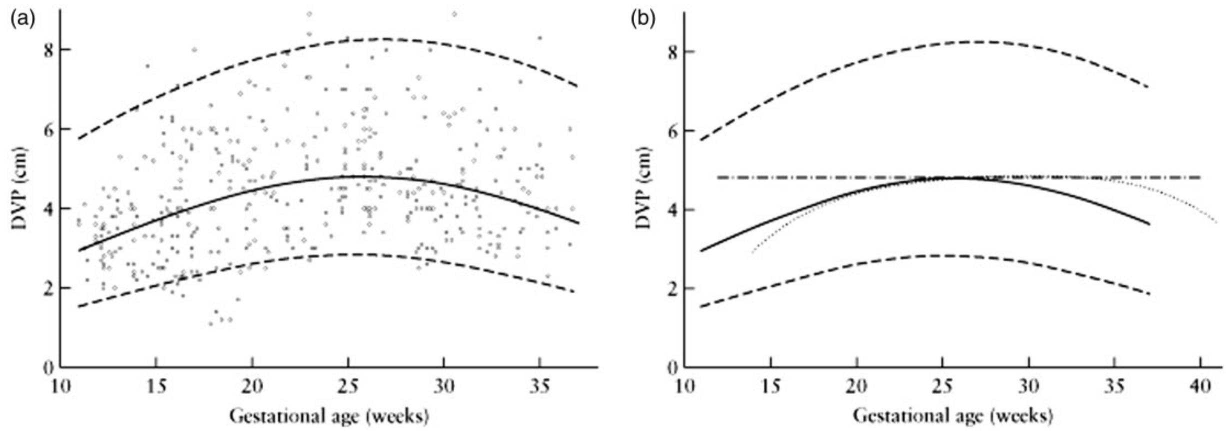

Figure 5. Variation of amniotic fluid volume with gestation.[50]

Table 2. Modified criteria for diagnosis of polyhydramnios/oligohydramnios in twin-to-twin transfusion syndrome affecting monochorionic twin pregnancies.[50]

Gestational age	Criteria for diagnosis
<18 weeks	Oligohydramnios in donor sac: DVP $\leq$2 cm Polyhydramnios in recipient sac: DVP $\geq$6 cm
18–20 weeks	Oligohydramnios in donor sac: DVP $\leq$2 cm Polyhydramnios in recipient sac: DVP $\geq$8 cm
>20 weeks	Oligohydramnios in donor sac: DVP $\leq$2 cm Polyhydramnios in recipient sac: DVP $\geq$10 cm

DVP: deepest vertical pocket.

and instrument choice and reduce the operative time which should also reduce the risk of procedure related complications.

Post-operative follow up after laser intervention for TTTS should involve regular ultrasound surveillance with particular focus on identification of recurrent TTTS (which occurs in up to 14% of cases), new onset TAPS (reported in up to 13% of cases),[56] limb abnormalities related to thrombi or amniotic bands and cardiac function in addition to close monitoring of fetal growth. It is expected that the polyhydramnios should have resolved by 14 days and cardiac dysfunction by one month. Common protocols for surveillance usually provide for weekly ultrasound for the first fortnight while subsequent scans can be fortnightly if there is evidence of clinical resolution. These follow-up scans should measure MCA-PSV to screen for TAPS and undertake detailed examination of brain, heart and limbs at each examination.

Selective fetal growth restriction in monochorionic twins

The diagnosis and management of selective fetal growth restriction in monochorionic twin pregnancies differs significantly from that in dichorionic pregnancies because of the nature of the interdependent placental circulation. The reported criteria for diagnosis of sFGR are highly variable, including AC discrepancy, finding one twin with AC <10th centile, discordance in birthweight or EFW and finding one twin to have an EFW <10th centile. This variation in diagnostic criteria has led to significant heterogeneity in reported outcomes of pregnancies diagnosed with sFGR, but consensus has recently been reached on the definition of sFGR in in order to standardise reporting in observational studies and trials of interventions in these pregnancies[57] (Table 3).

The degree of growth discrepancy in monochorionic twin pregnancies is thought to be linked to the degree of discordance in placental share[58] where sFGR in DC pregnancies is more similar to placental insufficiency in singleton pregnancies. While unequal placental sharing is the cause of sFGR in MC pregnancies the clinical outcome is determined as much, if not more, by the number and type of vascular anastomoses between the twins. These can be mapped using colour Doppler ultrasound to better understand the likely prognosis.[59]

In singleton and DC twin pregnancies affected by growth restriction, umbilical artery Dopplers (UAD) are used to monitor fetal wellbeing and prompt intervention when deterioration is identified. In MC pregnancies the circulation of the co-twin affects the pattern of the UAD in the growth restricted twin, requiring an

Table 3. Consensus criteria for diagnosis of selective fetal growth restriction (sFGR) in twins.[57]

Any twin pregnancy with the solitary parameter	MC pregnancy with at least two contributory parameters	DC pregnancy with at least two contributory parameters
EFW in one twin below the 3rd centile	EFW of one twin <10th centile	EFW of one twin <10th centile
	AC of one twin <10th centile	
	EFW discordance >25%	EFW discordance >25%
	Umbilical artery PI of the smaller twin >95th centile	Umbilical artery PI of the smaller twin >95th centile

EFW: estimated fetal weight; AC: abdominal circumference; PI: pulsatility index.

Table 4. Classification of pregnancies affected by selective fetal growth restriction (sFGR) in monochorionic twin pregnancies according to umbilical artery Doppler findings at diagnosis.[60]

Classification	Description
I	EFW in one twin <10th centile but positive end diastolic flow in the umbilical artery Dopplers
II	EFW in one twin <10th centile with absent or reversed end-diastolic velocities in one or both twins
III	EFW in one twin <10th centile with intermittently absent and reversed end diastolic flow in the umbilical artery Doppler

EFW: estimated fetal weight.

understanding of how placental anastomoses affect umbilical artery flow in interpreting UAD findings in these pregnancies. The UAD findings at diagnosis of sFGR are associated with clinical outcomes. The classification of sFGR in MC pregnancies is by UAD findings at diagnosis[60] (Table 4) and relates closely to the number and type of vascular anastomoses in the placenta. In type 3 sFGR with intermittent absent or reversed end diastolic flow (iAREDF) (Figure 6), large arterioarterial anastomoses allow compensatory flow from the larger twin but also permit acute transfusion events which may cause unpredictable mortality and morbidity in either twin.

Twin anaemia-polycythaemia sequence

TAPS is an imbalance in haemoglobin without a volume distribution disparity in monochorionic twins. It is most commonly seen after fetoscopic laser coagulation for TTTS, although the risk of TAPS is reduced by use of the Solomon technique for FLC.[61] Regular screening for fetal anaemia and polycythaemia using the middle cerebral artery (MCA) peak systolic velocity (PSV) is of benefit in high risk MC pregnancies including both those treated by laser or those affected by both TTTS and sFGR.[27]

A PSV $>$ 1.5 MoM (indicative of anaemia) associated with an MCA PSV in the other twin of $<$1 MoM (indicative of polycythaemia) is required for the diagnosis of TAPS.[62] Combining the degree of MCA PSV discrepancy with abnormal fetal Dopplers or hydrops has been used to generate a staging system that can guide intervention and postnatal expectations (Table 5).

Conjoined twins

The rarest complication of monochorionic pregnancy is conjoined twins, a condition resulting from very late splitting of the blastocyst and occurring in only 1% of monochorionic twin pregnancies.[7] Advances in ultrasound mean that conjoined twins are most commonly identified in the first trimester when many parents will opt for termination of pregnancy in view of the high risk of morbidity and mortality in an ongoing pregnancy. In families choosing to continue pregnancies, around 25% would be expected to survive to discharge and almost all with significant morbidity.[63] The prognosis is ultimately determined by the degree and site of the junction between the twins, and therefore detailed ultrasound studies are necessary to fully explore the nature of the connections between the twin pair. The most common site of union is at the thorax with the twins facing each other, and bowels, liver and hearts may be shared. Mapping blood vessels and structures can help plan postnatal surgery – where delivery is planned, it should be by caesarean section in a unit equipped to meet the surgical needs of the babies.

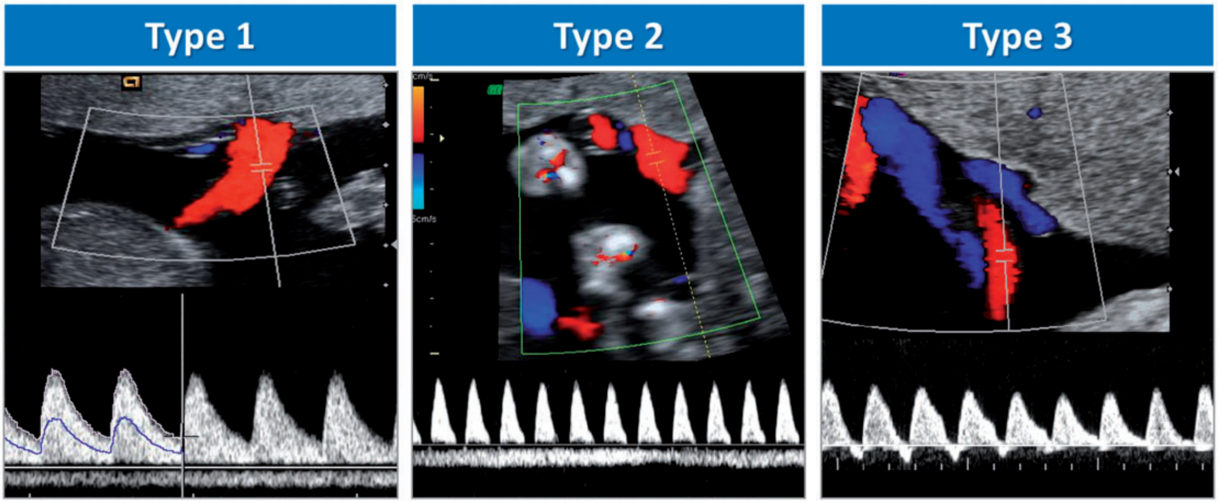

Figure 6. Patterns of umbilical artery Doppler flow in selective fetal growth restriction (author's own images).

Table 5. Twin anaemia-polycythaemia sequence classification.[62]

Stage	Antenatal	Postnatal
I	MCA-PSV donor >1.5 MoM and MCA-PSV recipient <1.0 MoM, without other signs of fetal compromise	Intertwin Hb difference (g/dL) >8.0
II	MCA-PSV donor >1.7 MoM and MCA-PSV recipient <0.8 MoM, without other signs of fetal compromise	>11.0
III	stage 1 or 2 changes in MCA-PSV, with cardiac compromise of donor	>14.0
IV	Hydrops in donor	>17.0
V	IUFD of either fetus in a pregnancy known to be affected by TAPS	>20.0

MoM: multiples of the median, IUFD: intra uterine fetal demise, MCA: middle cerebral artery, PSV: peak systolic velocity.

Cervical length measurements in twin pregnancies – useful or not?

Cervical length measured at transvaginal ultrasound has been shown to be associated with the risk of preterm birth and is commonly used for prediction of preterm birth in women with singleton pregnancies at high risk of preterm delivery although not yet recommended for routine screening in unselected populations. Since twins are at a greater risk of preterm birth than singletons and the majority of the increase in neonatal morbidity and mortality in twins is attributable to prematurity,[6] accurate screening and effective prevention for preterm delivery in twins are highly prized goals. Screening with cervical length at 18–22 weeks in multiple pregnancies is recommended by ISUOG[7] where the cut off used is <25 mm and SOGC.[12]

Unfortunately, although cervical length is associated with preterm delivery in twins, the sensitivity is lower than in singleton pregnancies,[64,65] suggesting that the mechanism underlying preterm labour in multiple pregnancies may differ from singletons.

There have been concerns regarding the value of cervical length screening in twin gestations where the sensitivity is low and the available prophylactic interventions had limited evidential support. For this reason, routine cervical length screening is not currently recommended by NICE[66] or the ACOG.[38] This guidance will likely have to be re-evaluated in light of new evidence showing that progesterone reduces preterm birth in women with twin pregnancies and a cervical length of <25 mm.[67] Further studies investigating the use of cerclage and Arabin pessaries in selected high-risk pregnancies are awaited, but screening for preterm birth in twins is an area where practice is likely to change in view of the emerging evidence.

Conclusion

Ultrasound is a vital tool at every stage of the management of twin pregnancy, permitting a detailed appreciation of the anatomy and interdependent fetal physiologies antenatally. As twin pregnancies increase in frequency, the need for the sonographers to be familiar with the complications of twin pregnancies and optimal surveillance will only increase.

Future research will validate the use of NIPT in twin pregnancies, identify further tests for the prediction of preterm delivery in twins and create prediction models for screening for pre-eclampsia in twin pregnancies, but the cornerstone of management of twin pregnancies is likely to be regular surveillance ultrasound monitoring for potential complications for the forseeable future.

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